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HOLLYWOOD'S DIGITAL BACKLOT, 2000–PRESENT

Stephen Prince

For the director Ben Affleck, the set designs in *Argo* (2012) had to be carefully articulated in ways that encouraged audiences to become immersed into the period of the Iranian hostage crisis in 1979. The film, which depicts the seizure of hostages from the U.S. embassy by Iran's Revolutionary Guards, has three main settings—Iran, Hollywood, and Washington, D.C. Each of these is rendered in persuasive period detail. Brief glimpses in the film of Iranians in the revolutionary Khomeini period munching Kentucky Fried Chicken at one of that chain's fast food outlets, for example, or the historical artifact of pneumatic tubing present in the offices of the State Department and CIA, were based significantly in period research and documentation.

Affleck regarded production design as a subliminal factor, affecting viewers' reception of a film in ways that are significant but go beyond what an audience consciously notices.

I believe that audiences care about set decorating . . . they just don't know it. That's how you sink an audience into the reality of something, you know. That's why I photograph it really closely. That's why I incorporate

it into the scene, because that's taking it from a movie to a real place. Because how we identify reality in our own minds is by the things that are very close to us, the things that are literally the set decoration of our lives. And the set decoration in movies has got to mirror that accuracy in order for the audience to get invested.¹

The actor Ed Harris has appeared in numerous films since the 1970s and has directed two films, *Pollock* (2000), a biopic of Jackson Pollock, and a western, *Appaloosa* (2008). As someone who has worked in front of and behind the camera, he understands the depth and the nuances that the right set decorations bring to a film. “The more specific, the more detailed, the more authentic. . . . Everything makes a difference. You have to work less as an actor, the more specific things are around you.”²

As Harris suggests, production design is an art of the specific, defining setting, character, and story through the articulation of sets, props, and costumes. Although digital filmmaking is now firmly ensconced as the norm in Hollywood, production design continues to operate within many of its familiar contexts and parameters. If one looks at the Academy Award winners for Production Design or Art Direction since 2000, one finds that, as in past decades, they are heavily weighted toward period films—films set in real historical periods, as in *Lincoln* (2012), or in fantasy realms, as in *The Lord of the Rings: The Return of the King* (2003). Moreover, as the remarks by Affleck and Harris demonstrate, sets remain of crucial importance to directors and actors, and the digital era has not altered this fact. Director David Fincher notes that digital filmmaking retains the importance of production design. “I do see a day where if you have to go back and do a re-shoot of a scene, you will have made high-resolution photographs of that set and you will be able to just go to a blue-screen stage and call it up. But you still will have had to have built it the first time.”³ Fincher's *Zodiac* (2007), *The Curious Case of Benjamin Button* (2008), and *The Social Network* (2010) are digitally intensive films, and yet, he insists, “sets are really important . . . almost more important for directors than actors.”

Production requires sets or locations, and a production designer delegates tasks to an art director and to subsidiary staff. This hierarchy of labor has remained consistent in the digital era. As art director Sarah Horton (*The Bourne Supremacy* [2004], *V for Vendetta* [2005], *The International* [2009]) points out, the production designer helps to establish a film's visual identity and delegates the task of realizing this identity to the art director. “The Production Designer establishes a kind of visual scaffolding, defined by color, light, texture, and contrast in which I [as the art director] am free to operate. In discussions with the Production Designer, the Art Director is responsible for the construction of the sets and they can take many forms. It can be a set in the studio . . . it can be a location where shooting takes place” or a mixture of both.⁴

Sets and Props in Digital Moviemaking

Physical sets and props have maintained their place in production as the industry has transitioned to digital moviemaking. In large part, this has to do with the sense of reality that physical things convey. As Oscar-winning production designer Sarah Greenwood (*Pride and Prejudice* [2005], *Atonement* [2007], *Sherlock Holmes* [2009]) remarks, “I like tangible things. I like lighting, texture and atmosphere that the digital world doesn’t have.”⁵ Doing the research and finding the right sets, props, and furnishings to characterize a film’s story world and its characters remain as important today as they were in cinema’s analog era.

The Help (2011) portrays the relationship between black maids and the white housewives they work for during the civil rights era of the early 1960s. To aid in visualizing this world, the production design team studied magazines, family photos, books, and home movies collected by people living in the Mississippi locations where the film was shot. Set decorator Rena DeAngelo noted, “The beauty of shooting this movie in Mississippi was that it was all there. I really thought I was going to be driving all over creation looking for all the dressing. But aside from the four trips we made to Memphis, we sourced much of it in the fantastic antique malls of Mississippi. Every one of them was a treasure trove of some aspect of Southern life.” DeAngelo obtained access to a department store in Greenwood, Mississippi, that had been closed for thirty years. “It had all the display cases, shelving, mannequins, lighting fixtures, bolts of fabric, signs, hundreds of unopened boxes of blinds from 40 years ago, Christmas decorations and window displays. . . . That store was a gold mine.”⁶

Even when a film’s story takes place in a fantasy realm, the physicality of real props may be a prized asset for the production. J. J. Abrams, director of *Star Trek Into Darkness* (2013), points out, “Obviously, you can’t do a movie called ‘STAR TREK’ and not have green screen elements, but one of the things we’ve



FIGURE 32: Although much in *Star Trek Into Darkness* (J. J. Abrams, 2013, art dir. Ramsey Avery, prod. des. Scott Chambliss, set dec. Karen Manthey) is achieved via digital compositing, the deck of the starship *Enterprise* was built as an extended, connected set in order to facilitate the actors’ performances.

continued from the first movie is the idea of finding locations or building sets whenever we could to create a world that isn't synthetic or sterile, but feels very, very real.⁷⁷ The starship *Enterprise*, for example, was designed as a large, connected space in ways that would facilitate the actors' performances (figure 32). "We had the opportunity this time to build a set that was contiguous so that we were able to go from the Bridge down a hallway, into the Turbo Plaza area and go around a corner into the Med Bay," Abrams notes. "It gives the ship a sense not only of scale, which is a fun by-product, but a real sense of being interconnected." Set decorator Karen Manthey added: "I understand and believe in the importance of the set during the shoot as a world for the actors to inhabit. When we present a set to the director, the job of that set is to lead to an enhanced performance from the cast and crew, and with that, a better final product. That understanding has become a motivator for me in regard to working at the highest performance level possible."⁷⁸

One of the extraordinary shots and scenes in contemporary cinema is the Dunkirk beach sequence in Joe Wright's *Atonement*, filmed as a single, extended five-and-a-half minute Steadicam shot. Dunkirk was a beach resort in France where the English army in World War II massed for an evacuation, and the filmmakers aimed to capture the surreal quality of wounded and dying soldiers huddled amid a seaside resort. Filming at the town of Redcar on the eastern coast of England, the filmmakers recruited 1,000 extras from town to populate the beach, costumed as English soldiers preparing for the evacuation. The camera prowls throughout an extensive location dressed with often-large sets that include a Ferris wheel, a gazebo bandstand, a tin barge beached on the sand, tents, jeeps, motorcycles, and buildings fronting the sea. In his review of the movie, Roger Ebert remarked that he could not tell if the sequence was CGI, and this ambiguity—is it real or not?—is a new factor at work in the reception of contemporary film, where much that may not be physically real nevertheless can seem to be so. Indeed, audiences might tend to think that the Dunkirk beach scene was created digitally because scenic design on this scale today often is a digital matter. Rather than being built on a large scale, they can be digitally augmented or extended (color plate 11). But in the case of *Atonement*, the beach settings were found and built but not digitally engineered. The sets were dressed and filmed in a traditional fashion, and Greenwood, who won an Oscar for the film, feels that the sequence is special because it was physically designed and staged as the viewer sees it. "If we were making it now, it probably would be CG and it stops being so incredible and amazing."⁷⁹ Had the background been a digital creation, it would have been shot differently, she maintains. Although the scene originally was planned to be a montage of discrete shots, the physicality of the sets, the light at golden hour, the ocean tide itself convinced Wright to film it as a single, extended shot (figure 33). It was the weight and the materiality of the location that influenced his shooting decision.

If you knew that you were going to do it digitally, you'd have done something massive and bigger. Instead of having a thousand people on the beach, you'd have a hundred thousand. But having a hundred thousand CGI people on the beach doesn't make it better at all, actually. What made that shot work was the human drama, and the pain, and every little moment of that sequence told a story. And that was the combination of everything being there on that day, on that moment of the day, of Joe designing to shoot that way, the light and everything just happened to fall into place well. It could've been torrential rain and zero visibility, but if you'd not even attempted it and said that you'd do it in CGI, you would've ended up with a very different moment in the film.¹⁰

Greenwood speaks from a traditional perspective that values the physicality of real sets and props, and she may be correct in her observation that a digital lure for filmmakers often is toward ever more grandiose expressions. The software Massive enables crowd replications that, as its name suggests, easily facilitates what the film scholar Kristen Whissel has called “the digital multitude,” the gigantic hordes seen in films like *The Lord of the Rings* trilogy.¹¹ And yet, while art director Sarah Horton finds that digital set extensions and augmentations are becoming more prevalent in cinema today, she points out that digital work often is tied to what a production design and set designer have accomplished with real objects and materials. “My own experience is that visual effects are often sourced from the built sets using and extending from the physical surfaces and lighting. It's much more difficult, time-consuming and expensive to start from nothing in the computer.”¹² Thus, in an era of digital filmmaking, the physicality of real sets



FIGURE 33: The Dunkirk beach evacuation from *Atonement* is shot in a single, extended take, with the camera exploring a massive location dressed with three-dimensional sets in a traditional fashion (Joe Wright, 2007, art. dir. Ian Bailie, prod. des. Sarah Greenwood, set. dec. Katie Spencer).

and props retains a significant place in Hollywood production. But, though it is significant, the built set or found location is not a prerequisite for production. Digital production design enables films to move far away from the physicality of settings. And that movement is where the striking developments in production design after the year 2000 frequently are found.

Digital Imaging

The most significant trend in Hollywood production design in the new millennium is tied directly to the diffusion of digital imaging tools. This trend is a return to the tradition of back-lot filmmaking, which had been the standard industry practice during the classical studio period. As its name suggests, back-lot filming enabled the studios to make movies using studio properties rather than going on location for production. Errol Flynn, for example, fought the Japanese in World War II in Raoul Walsh's *Objective, Burma!* (1945) not in Southeast Asia, where the story is set, but on Warner Bros. soundstages. Another Flynn epic, *The Sea Hawk* (1940), was a dry-dock picture. Nothing was shot at sea for its story about sixteenth-century naval warfare between England and Spain. All of its seafaring scenes were filmed in a state-of-the-art studio tank so big that it could accommodate full-scale models of period warships and with a painted muslin cyclorama to represent the sky.

In these earlier decades, movie characters interacted in front of rear-projected backgrounds that represented beaches, foreign locales, or the traveling landscape visible outside an automobile window. While there were some exceptions—John Ford shot many of his westerns on location in Monument Valley—the dominant studio practice was to synthesize a location using partial sets, miniature models, matte paintings, rear projection, and composites achieved on the optical printer. During the 1950s, as the classical production system entered a period of crisis, filmmakers began moving outside of the studios to shoot on actual physical locations. *On the Waterfront* (1954) provides a powerful example of what can be achieved by the skillful integration of authentic locales into the aesthetic design of a film. As the studios declined during the 1950s and into the 1960s, location filming increasingly became a normative practice for filmmakers who wanted to eschew the conventions of studio filmmaking. The shift seemed so widespread and permanent that many studios shut down their matte painting departments. The movies that today are known as the American New Wave exemplified the virtues of location work. When Dennis Hopper took a 16mm camera and loaded it with a fast, grainy stock to film *Mardi Gras* for a sequence in *Easy Rider* (1969), it amounted to an artistic manifesto rejecting the studio tradition of simulated landscapes and highly polished image-making. The documentary-like patina of realism in *The French Connection* (1971) is due in significant part to its canny use

of Manhattan streets and the ways that cinematographer Owen Roizman captured them using the available ambient lighting conditions.

As location work succeeded the simulated landscapes of the classical studio period, it came to be seen as a method of achieving greater realism or authenticity in a film. At a minimum, the changeover ushered in a kind of rivalry between what Charles Affron and Mirella Jona Affron called “the advocates of constructed sets and the partisans of real streets and buildings.”¹³ While each option remains available to filmmakers today, the digital revolution has revived and reinvigorated the back-lot tradition of simulated screen environments. This is because digital imaging has provided filmmakers with a more extensive and effective set of tools for envisioning locations and for making them seem credible within the terms of a given film’s story world. While *Star Wars* (1977) was not a digital film, its tremendous success pointed to the future. George Lucas loved matte paintings and the entire tradition of artificial locations that they enabled, and his enthusiastic embrace of visual effects and built environments, coupled with the popular response to the movie, helped to make this tradition real and vital once again. And then Lucas helped lead the industry into its digital future.

These developments were synergistic, one reinforcing the other, because production design in the studio era had always been about more than placing live actors on sets and filming the scripted scenes. Key to understanding production design in the back-lot tradition is recognizing that the sets and the depicted environments to which they pointed tended to be radically incomplete. They were completed when conjoined in a final composite with other image elements that were created separately. When Anthony Keane (Gregory Peck) walked into Hindley Hall in *The Paradine Case* (1948), the actor was filmed on a minimalist set consisting of a floor, a doorway, and a wall, and matte paintings were composited with the live-action footage to extend the set and create the visual impression of a sumptuous mansion. Matte paintings often worked in this fashion to extend and complete partial sets, as did miniature models, especially hanging foreground miniatures that were positioned between the camera and the live-action elements. When Scarlett O’Hara returns to Tara in *Gone with the Wind* (1939) to find it empty and desolate, she enters the mansion house and its staircase and upper floors are a foreground miniature.

Narrative cinema has been an art of the fragment. Shots provide viewers with partial views of the action, and production designers in the back-lot tradition build only what will be seen by the camera, and even that is frequently incomplete at the point of live-action filming. Composite shots blend live action with hanging miniatures, matte paintings, and process photography, making production design about more than sets. The built environment for a feature film consists of the physical sets and props as well as various kinds of composited imagery that extend, elaborate, and fill in what has not been built directly for live action. If all of this is done well, viewers will experience screen spaces

that seem holistic and contiguous rather than as the disconnected fragments that they truly are.

Digital imaging has not changed this tradition but, in fact, has intensified it because digital composites can be more seamless and subliminal than photo-chemical composites achieved on an optical printer and because digital imaging has transformed some of the traditional tools of production design, making them more malleable and articulate than they could be in the analog tradition.

Consider matte paintings, for example. During the era of analog cinema, these were 2D paintings used to extend backgrounds or other portions of a screen environment, and they were composited with live action in post-production. In general, cameras were locked down when filming shots that would have matte paintings added to them because the resulting motion parallax created by camera movement would reveal the painting to be a 2D element and one that was not as far from the camera as its depicted landscape was meant to be in the story world. Introduced in the 1950s, motion control camerawork enabled panning shots to be synchronized on a production camera and a process camera so that a pan executed live on set with actors could be replicated on the matte painting that would later be composited into the shot. But, in general, throughout the era of analog cinema, matte paintings were static, two-dimensional elements that constrained what a filmmaker might do with the camera in shots where they appeared.

The famous pull-back in *Gone with the Wind* is designed to appear as a crane shot. It shows Scarlett O'Hara (Vivien Leigh) and her father (Thomas Mitchell) as silhouettes standing beside a tree, with the mansion of Tara in the distance. The shot composites live action (stand-ins for Leigh and Mitchell playing the characters), a miniature model (the tree), a matte painting of a stormy sky, and a matte painting of Tara. Registration among these elements is less than perfect; they jiggle noticeably when the pull-back begins. The simulated camera move is produced on the optical printer as a zoom-out effect, and the 2D nature of the matte paintings is apparent because there is no motion perspective accompanying what is meant to appear as a camera move.

Digital Environmental Design

In the digital era, matte paintings are dynamic, three-dimensional components of a composited environment. When the actor Mark Ruffalo, playing a police detective, walks down a digitally augmented San Francisco street in *Zodiac*, the urban environment glimpsed at the end of the street is a matte painting, and as the moving camera follows Ruffalo, the matte painting is animated with the motion perspective produced by the hand-held camera (the process is called matchmoving). It undergoes the same kinds of transformations as near-ground objects. The motion control camerawork creates an organic bond between painting and

real environment, providing the coordinates that enable the matchmove and the compositor to blend the two as an imperceptible illusion. As this example demonstrates, digital matte paintings exhibit depth, dimensionality, and the perspective changes produced by a moving camera. To the extent that it is interactive with other scenic elements or characters in the frame, a digital matte painting is not a discrete and separable component in the composited scene, as it was in the old analog days. As Craig Barron, the co-founder of Matte World Digital and the co-author of *The Invisible Art*, the authoritative history of matte painting, states, “It is difficult to categorize what a matte painting shot is today. . . . Most filmmakers still call what we do matte shots, and we like that because we see our work as an extension of the original craft. But, it’s more accurate to say we are involved in environment creation.”¹⁴

As Barron suggests, matte paintings today are subsets of digital environment creation, and I would suggest that production design itself increasingly is understood as a form of digital environment creation since even pictures shot on real locations will undergo digital image processing in their final stages of production. Accordingly an art director and a virtual art director will collaborate on a production, one handling built sets and the other handling their virtual counterparts.

A digital matte painter works with electronic brush and paints using programs such as Autodesk Maya and Adobe Photoshop. These programs transformed the nature of matte painting. Photoshop, marketed by Adobe in 1990, enabled filmmakers to paint over visible matte lines, blending and blurring image elements, changing pixel information to create perfect matches between different image types. Photoshop integrates well with Maya as part of an image production pipeline, enabling efficient creation and animation of matte paintings. The digital environments that are part of contemporary production design frequently begin life as a concept sketch that can be directly imported into Maya, where an artist can construct the scene geometry onto which a matte painting will be projected. This geometry is a set of primitive cubes and cylinders, constructed of polygons (the building blocks of digital geometry), that will underlie the buildings, streets, signage, cliffs, bluffs, mountains, or whatever other scenic elements may be involved. Maya provides a toolset that facilitates the warping and extrusion of polygons so that they can be extended across the location as sketched. In doing so, the artist constructs the scene’s three-dimensional information. The geometry is constructed according to a camera projection that has been preset. This projection establishes the camera’s view of the scene in terms of lens focal length, depth of field, camera position, aspect ratio, and camera movement. Maya also permits the creation of lighting and color effects, so that painting can be done during the scene building stage. Directional lights can be established to create shadows and highlights and various compositing passes can be executed. These can include an occlusion pass (to calculate which objects are obscured by other objects according to the camera projection), a specular pass (calculating highlights according to

viewing angle and light sources), Z-depth pass (calculating object distances from the camera, essential information for animating scenes with lots of activity), and alpha channel-passes (establishing degrees of translucency and opacity in scenic elements). (Digital compositing is a multi-pass process. Each pass renders discrete types of information, and rendering is the process of converting the 3D computer information into a 2D image suitable for cinema viewing.)

If there is to be a camera move on the painting without a live-action plate, this can be key-framed in Maya as an animated move across scene geometry. If the painting will be composited with a live-action plate that was filmed with a camera move, then the move can be motion-tracked with a matchmoving program and imported into Maya or a compositing program like Shake or Fusion for final render. Maya can save all this information as a PSD file, which is a proprietary Photoshop format, for use in that program. The matte painting will be created in Photoshop, and the artist can import the render information from Maya, which will convey an abundance of lighting and color information. The painter can lift textures from photographs or from miniature models and can clone or tile this information in order to build the matte painting.

In *Cowboys and Aliens* (2011), for example, the alien spaceship appears as a huge tower looming above the desert floor. In many shots the tower was a miniature model. In others, it was a matte painting, and the painting was textured with photographic information derived from the model. *The Lord of the Rings* trilogy featured numerous matte paintings establishing distant vistas, and these were textured with photographic information derived from New Zealand's skies and mountains. The opening shot of *Changeling* (2009) is a crane from the skyline of Los Angeles, circa 1928 (the period setting of the story), to the wooded neighborhood street where Christine (Angelina Jolie), the principal character, lives. The skyline is a camera-projected matte painting animated with a panning shot that is matchmoved to a live-action camera craning down to a suburban street on a San Dimas location. The transition from the matte painting to live action is finessed with some digitally animated trees composited into the shot to hide the join between the painting and the location. As these examples suggest, matte paintings today incorporate numerous image types as well as animation and live-action perspectives. In this sense, they are more than "paintings" and, arguably, they are more important than ever to cinema now that it has entered its digital era.

Roland Emmerich's *Anonymus* (2011) exemplifies the capabilities and artistry of digital environmental design. The setting is the Elizabethan era, and the story recounts an alternative version of accepted history in which Shakespeare is a witless lout fronting for the true author. Most of the film's numerous exterior shots were filmed with actors before greenscreen. (Greenscreen or, alternatively, bluescreen enables the efficient extraction of live-action elements from the colored background so that they may be composited with digital sets, landscapes, or characters.) Many of the exterior locations appearing in the film were digital



FIGURE 34: Many of the exterior locations in *Anonymous* (Roland Emmerich, 2013, art dir. Stephan Gessler, prod. des. Sebastian Krawinkel, set dec. Simon Boucherie) were digital creations into which the actors were composited after being filmed on greenscreen.

creations, and the actors were inserted into these with very convincing results. Only a few shots betray their origins as digital composites (figure 34).

The exteriors were created by drawing on several sources of documentation. One of the film's producers traveled throughout England shooting photographs of surviving sixteenth- and seventeenth-century buildings. Using a Canon 5D camera, a high-end DSLR capable of shooting images at 4K resolution, he compiled a visual record of period architecture consisting of some 50,000 photographs. These were used in several ways. They provided information about the structural characteristics of buildings in that period that the effects artists used in constructing the digital buildings that appear in the film. The photographs revealed that the building materials were often warped and asymmetrical. Visual effects supervisor Marc Weigert said, "I'd always assumed that old buildings like that had started out straight, and had then become crooked through the years. But they were actually built that way, with weirdly crooked timber beams and so on. So we built the houses accurately, with squared lines; and then we went through and warped them and otherwise modified them to make them crooked. It was important that they not look symmetrical . . . and that was a daily fight in dealing with computer models."¹⁵ Indeed, the polygons that underlie digital 3D geometry are plane surfaces enclosed by straight lines. Computer modeling thus has a built-in bias toward symmetry and hard, clean edges, and the artistry of digital modeling in cinema often consists of finding ways of overcoming the computer's preference for symmetrical perfection. Things often need to be roughened up and made dirtier. A "dirt pass" in rendering, for example, consists of adding environmental grime appropriate for the objects in a scene. The irregularities found in many natural forms need to be carefully emulated and added to the characters and humanly made objects in a digitally created scene in order

to make it appear natural.

The *Anonymous* designers also used the photographs for photogrammetry (a method of mapping the camera's lines of sight across several images in order to recover the underlying dimensional structure of the pictured objects and their physical layouts). Photogrammetry enabled the film's effects artists to model the photographed buildings in three-dimensional computer space and to use these models for generating hundreds of buildings needed for wide views of London that the film would show. Ground floors, roofs, second stories—these were modeled in a modular and recombinant fashion in order to generate a city's worth of period buildings.

Photogrammetry is widely used in contemporary cinema when artists need to construct digital environments that are modeled on real locations or objects. One of the most audacious shots in David Fincher's *Zodiac* is an aerial flyover of the Port Authority Terminal in San Francisco. Since *Zodiac* is a period film dealing with the Zodiac killings in the late 1960s, the filmmakers could not go on location and simply film the Port Authority—too much had changed in the intervening years. The area no longer looked as it did in the period. The harbor as it appears in the flyover is an all-digital environment built from photogrammetric analysis of city blueprints of the area as well as photographs taken in the period by a U-2 spy plane. Lighting information was recovered as well from the period photographs, enabling the artists to animate shadows and highlights on buildings that were consistent with what would have been found in the late 1960s. The dimensional structure of a real scene can be recovered from even a small number of photographs, and textures from those photographs can be projected onto the digital environments according to the view established in the scene's camera projection. I described this as an audacious shot because the digital artistry is both flaunted and subliminal. The action in the shot takes place in bright daylight, and it's an establishing shot so it is held onscreen for some time. These conditions can be brutal for a digital artist because they can reveal the underlying architecture of the image, but in the case of *Zodiac* the digital environment has been modeled perfectly.

One of the scenic highlights of *Iron Man 4* (2013) is a helicopter attack on Tony Stark's (Robert Downey Jr.) mansion, built on the cliffs of Point Dume in Malibu. Zoning and property restrictions prevented the filmmakers from doing any filming in that area, so all of the exterior action is digitally constructed. (Interiors that show the mansion cracking and leaning from the rocket attack were filmed on sets mounted atop a gimbal, much as Chaplin had done to simulate a rocking ship nearly 100 years earlier in *The Immigrant* [1917], a parallel that demonstrates some of the essential continuities of filmic practice across analog and digital eras.) Unable to film on location, the visual effects house handling the sequence shot photographs at Point Dume and of surrounding buildings "to determine how much texture detail we would see at that time of day, how much the windows would reflect, what the sun did to the buildings over time, what the

shadows looked like.”¹⁶ This information was incorporated into the sequence’s digitally designed environment. The photographs also supplied the photogrammetric information that effects artists used to build a 3D computer model of Point Dume. The visual effects supervisor for the sequence pointed out, “There was no surveying required at all. It was all based off of photographic imagery.”

Returning our discussion to *Anonymous*, location photography also provided the filmmakers with the materials needed for a camera move. In the film a dramatic camera move descends into Westminster Abbey during a funeral. Salisbury Cathedral doubled for the location. Several three-dimensional environments were constructed based on a high-angle digital photograph looking down into the cathedral, each environment corresponding to a portion of the image. The photograph was then projected onto the 3D environments and a virtual camera move connected the environments with appropriate parallax effects. The result onscreen was an impressive virtual camera move from the upper story of the cathedral down toward the funeral below. The method employed to construct this shot was elegant and simple and one that numerous other films have used. An aerial flyover of a Cuban location in *Bad Boys II* (2003), for example, was constructed by projecting photographic textures of houses onto a wireframe environment and arranging a series of matte paintings on 2D planes at various removes from the virtual camera. Animating this material brought the virtual environment to life as well as the camera move. A similar effect introduces the Macau location in *Skyfall* (2012), where James Bond has traveled searching for an assassin’s employer. An aerial shot introduces an elaborate gambling casino surrounded by water and floating lanterns, with the city in the distance. The casino and its entranceway are a façade built on the Pinewood studio tank; the rest of what one sees are digital environment extensions and a matte painting. The flyover effect that simulates an aerial shot results from the animation of set, CG extensions, and matte painting. The shot combines 2D and 3D effects. The chief villain in *Skyfall*, Raoul Silva (Javier Bardem), lives on a remote island whose deserted metropolis is rendered as



FIGURE 35: The deserted island metropolis of the villain (Javier Bardem) in *Skyfall* (Sam Mendes, 2012, art dir. Chris Lowe, prod. des. Dennis Gassner, set dec. Anna Pinnock) is brought to life as a series of 2D and full 3D matte paintings.

a series of 2D and 3D matte paintings (figure 35).

The digital environments in *Anonymous* were created with realism as the aesthetic goal. They were not meant to look like a fantasy locale or like digital creations. The film's wide views of London were built and animated using period maps of the city, and the filmmakers aimed to place famous locations, such as the Tower of London, the Thames, and London Bridge in relation to the city as these were laid out. The film's Elizabethan locations no longer exist, but they can be built using the documentation supplied by maps and photographs, and the digital back lot enabled the film's actors to inhabit Shakespearean London in a convincing fashion.

Nevertheless, the film's extensive use of virtual environments to represent exterior locations is a little unusual in live-action feature filmmaking in 2013. More typically, digital environments supplement live-action sets as extensions and augmentations. Tom Hooper's production of *Les Misérables* (2012) provides some good examples.¹⁷ The story setting is nineteenth-century France, and live action was filmed on sets constructed at Pinewood Studios and on locations in England and France. This live-action material subsequently became a series of "plates" (the industry term for live-action material that has been scanned for use in a digital composite). As Sarah Horton noted, plates often furnish the references used by digital artists for creating color, textures, and lighting in matte paintings or other composite materials. In the case of *Les Misérables*, live-action plates were extended with period details that had been pulled from nineteenth-century daguerreotype panoramas of Paris. This enabled compositors to insert actors and settings filmed on the Pinewood stages into period backgrounds and the surroundings of streets in Paris. The compositing was complex because many shots featured groups of performers moving in complicated ways and camera



FIGURE 36: Live-action plates—in this case, the children running toward the camera—have been seamlessly composited with digital environments and elements of real locations to portray the nineteenth-century world of Victor Hugo's novel in the film *Les Misérables* (Tom Hooper, 2012, art dir. Grant Armstrong, prod. des. Eve Stewart, set dec. Anna Lynch-Robinson).

movement that had to be matchmoved in the digital environments (figure 36).

Digital Composites

When live-action plates are used in digital composites, the results are generally seamless. In this respect, composited environments, which have always been a part of production design, can be created today with more precision and a more convincing blend of elements. In the analog era of film, composited environments were created photochemically using optical printers—an interlocked process camera and process projector. The process camera photographed frame by frame each of the optical elements in a composite and used mattes to block portions of the frames on the dupe negative to prevent double exposures. The registration of matted areas often was imperfect, and visible matte lines tended to afflict the composite work. Moreover, a composite shot necessitated the rephotographing of footage to assemble the finished shot, so generational losses of image quality affected the results.

Digital composites do not rely on this kind of photochemical printing. A compositor works by transforming pixels according to numerical operations, and these transformations need leave no visible trace in the final results. Moreover, the alpha channel enables very efficient and clean matte extraction. The alpha channel is one of four channels in which digital images store picture information (the others being red, green, and blue). The alpha channel is grayscale and designates the relative opacity of a pixel (black is fully transparent, white is fully opaque). Using the alpha channel to set black and white values for selected areas of an image enables the creation of the male and female mattes used for extracting characters or other objects from a shot and their insertion into another background or setting. Tools like Z-depth mapping enable precise calculation of dimensional information within the frame, and compositors can use this to control depth of field information and the camera's projection of a 3D computer environment onto the 2D plane of cinema.

The alpha channel and Z-depth mapping facilitate the compositing of live-action plates with digital environment extensions as found in *Les Misérables*. The results are dynamic and spatially immersive. Perspective changes produced by camera movement are replicated uniformly across the live-action and digital elements, creating a perceptually persuasive bond between the elements of a composite. Actors can move into and out of the depths of the digitally augmented environments, so that the domains of live action and optical effects do not appear visibly separate as they did during the era of optical printing.

One of the big set pieces in *Les Misérables* is the funeral for General Lamarque, a hero of the revolution, which the filmmakers staged near the Bastille. The sequence was shot in Greenwich, England, and its wharf, the Admiralty Museum,

the Thames River, and the city itself—unmistakable British signatures—were all visible in the shots. The filmmakers had planned to use greenscreens to block those areas in preparation for digital set extensions, but director Hooper was shooting with multiple cameras, and their differing lines of sight were not compatible with greenscreening. Instead, these areas were rotoscoped, that is, their edges were articulated frame by frame as a matte so that they could be extracted from the shots and replaced with digital imagery of nineteenth-century Paris. Historical maps and paintings suggested how the Bastille was positioned relative to surrounding streets and buildings, and these environments were constructed and composited with the live-action plates.

The building that remains a centerpiece in the scene is part of Greenwich's Old Royal Naval College, which also appears at the film's conclusion as cheering throngs mass along a barricade in defiance of the government. The barricade was a practical set created by the art department as a small part of a much larger structure that appears in the film as a digital composite. The full digital extension was created from HDRI (high dynamic range images) of the practical set, used to establish texture references to be incorporated into the digital imagery. HDRI is a widely used application in contemporary film for the construction of digital environments when these are modeled on live-action filming. A high dynamic range image captures all of the visible light values in an environment, and in this respect it differs greatly from what a conventional photograph supplies.

Photography captures only a small spectrum of the visible light in a location. This fact seems to have been overlooked and neglected by theorists who construct accounts of cinema and realism based on the model of photography. A photographer intentionally must exclude from capture significant ranges of detail in the scene being photographed. By setting shutter speed and f-stop, the photographer determines what range of shadow and highlight detail will be preserved. A photograph cannot capture all of the information that the eye can see, but a high dynamic range image can do so. If a series of photographs are taken of a location, using exposure settings that produce a range of images, from under- to over-exposed, this range can be digitally combined to yield a composite photograph that preserves all of the exposure details captured in the individual photographs. The HDRI image provides a full reference of environmental light values, needed by a compositor in order to match the lighting and color in live-action plates with digital materials. In the case of *Les Misérables*' barricade, or the photographs of Elizabethan-era buildings in *Anonymous*, HDRI provides an important tool set for constructing the textures and ambient lighting values needed in digital set extensions.

Movie Magic Is Illusion, Not Fakery

In the analog era, production design followed a sequential process. The designer's

plans were sketched, followed by the construction of sets and costumes, and then live-action filming proceeded based on these. Environment extensions were achieved in post-production with matte paintings and other composited effects, produced on the optical printer. The diffusion of digital tools has made compositing and virtual art direction into activities ongoing with production. One of the major innovations of *Avatar* (2009) was the on-set compositing of live action with digital characters and environments. James Cameron filmed his actors in motion-capture gear while viewing their characters as digital avatars in the digital environments where they would appear. Using Maya, the film's virtual art department had constructed low-resolution environments of planet Pandora's flora and fauna that Cameron could composite on set with his actors. Using a camera rig dubbed "Simulcam," Cameron was able to create virtual camera moves as live action in the digital environment. These innovations shifted motion capture from post-production to production and enabled the director to step into the digital world on the live-action stage.

Russell Crowe's major song sequence in *Les Misérables*, when his character, Javert, sings about devotion to the law, is staged with his character atop the roof of police headquarters. The rooftop is a partial set, augmented with a digital panorama of Paris. The film's 3D effects supervisor built the scene in Maya and showed the rendition to director Hooper on set. It showed two camera projections, as the scene would appear if shot using an 18mm and a 24mm lens, to demonstrate the amount of city visible in each perspective beyond actor Crowe. The digital visualization assisted Hooper in his shot choice. Narrative cinema is an art of the fragment. The viewer's experience of wholeness and contiguity is an illusion constructed by filmmakers, and production design very often is about building and compositing environments that viewers are meant to understand as being co-extensive with a film's story world. In fact, however, the spaces of story world and production design are fabricated and engineered to sustain the narrative illusions of contiguity and wholeness. In *Argo*, for example, as an Iranian mob storms the U.S. embassy, several employees escape from the building using a back staircase. Filming and editing this action sustained an elegant illusion. The Veterans Administration Building in Los Angeles was used as a location for filming the interior scenes in the embassy, and Iranian street scenes showing angry crowds were shot in Istanbul. In the finished film, the employees go down the stairs and out the door into the streets of Tehran. In production, the actors were filmed walking toward a Veterans Administration doorway in a corner of the building. On location in Istanbul, production designer Sharon Seymour built a set on a raised platform above an Istanbul street that matched the VA doorway. The set contained a staircase running down to street level and a second door that opened onto the street. In Istanbul, the actors were filmed entering the set's doorway, going down the stairs, opening the second door and stepping out into the street. As edited, the action was seamless and created perfect continuity, but

it was an elaborate construction. As the film's cinematographer Rodrigo Prieto remarked, "The shot connects the locations in L.A. and Istanbul as if it had all taken place in Tehran."¹⁸

Production designer Paul Sylbert's long and distinguished credits include such classics as *One Flew Over the Cuckoo's Nest* (1975). He said, "The campfire scene at night in [the western] *Bad Company* [1972] was done on a sloped floor in a gym in Kansas. We do this all the time in movies. Movie magic is illusion, not fakery."¹⁹ Debra Granik's *Winter's Bone* (2010) was shot digitally using Red One cameras, on locations in the Ozark Mountains that matched those called for in the story. Granik and crew scouted locations for two years before filming began because realism and authenticity were important attributes of the film's style. But filmic style, even a realist one, necessitates construction. A climatic scene shows Ree Dolly (Jennifer Lawrence) taken by night to a pond by two sinister women who are meth dealers. There, Dolly finds the body of her murdered father. Dialogue shots among the women in the boat were filmed on a mock set on dry land, using a low camera angle to hide this fact. Other shots in the scene showing Ree reaching into the water were filmed on the pond. The style is realist, and yet the spaces on screen are not what they appear to be; as Sylbert noted, much is illusion but not fakery.

Filmmakers have always done this kind of thing and always will. Little about the nature of narrative cinema has changed in the digital era, although filmmakers now have tools that are more expressive, powerful, and nuanced than their forbears did in earlier generations.²⁰ But tools in themselves are not what counts. What counts is a filmmaker's intelligence and taste. Stanley Kubrick pointed out that Chaplin's films will probably last longer than anyone else's because of what Chaplin brought to the screen, not because of his filming methods. "If something is really happening on the screen, it isn't crucial how it's shot. Chaplin had such a simple cinematic style, but you were always hypnotized by what was going on, unaware of the essentially non-cinematic style. He frequently used cheap sets, routine lighting and so forth, but he made great films."²¹ Great films will continue to be made in a digital medium, but idea rather than method is what will make them so.